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REMARKS

This amendment responds to the Office Action dated September 15, 2003 in which the Examiner rejected claims 13-16 and 22-25 under 35 U.S.C. § 112, second paragraph, rejected claims 1, 8-11, 13, 15, 17-19, 26 and 27 under 35 U.S.C. § 102(b), rejected claims 1, 2, 8, 10, 11, 17, 19, 20 and 26 under 35 U.S.C. § 102(e) and rejected claims 3-7, 12-16 and 21-25 under 35 U.S.C. § 103.

Concurrently filed with this amendment is an annotated sheet to label Figures 1a to 1c prior art. Applicant respectfully requests the Examiner approves the correction. A replacement sheet will be provided when the corrections are approved by the Examiner.

As indicated above, claims 13 and 22 have been amended in order to more particularly point out and distinctly claim the subject matter which the Applicant regards as the invention. Applicant respectfully submits that the rejection to the claims under 35 U.S.C. § 112, second paragraph no longer applies. Therefore, Applicant respectfully requests the Examiner withdraws the rejection to the claims under 35 U.S.C. § 112, second paragraph. In addition, Applicant respectfully submits that the amendment does not narrow the literal scope of the claims.

As indicated above, claims 1, 8-10, 17-19, 26-27 have been amended to make explicit what is implicit in the claims. Applicant respectfully submits that the amendment is unrelated to a statutory requirement for patentability and does not narrow the literal scope of the claims.

Claims 1, 8-10, 17-19 and 26-27 claim a method of patterning a thin film, a method of manufacturing a thin film device, a method of manufacturing a thin-film magnetic head comprising a step of etching at least one strippable film using focused ion beam.

Through the method of the claimed invention, etching a strippable film by a focused ion beam as claimed in claims 1, 8-10, 17-19 and 26-27, a thin film to be patterned is not directly etched by the focused ion beam so that the thin film to be patterned can be prevented from being damaged due to electric charge. In addition, pattern resolution or patterning precision can be improved. The prior art does not show, teach or suggest the invention as claimed in claims 1, 8-10, 17-19 and 26-27.

Claims 10, 11, 13, 15 and 17 were rejected under 35 U.S.C. § 102(b) as being anticipated by *Morimoto et al.* (J. Vac. Sci. Technol. B, Vol. 5) (1), January/February 1987).

Morimoto et al. appears to disclose the fabrication process of the mushroom-gate GaAs MESFET illustrated in Fig. 1. After source and drain electrodes were formed on a substrate with an epitaxial-grown *n*-type active layer [Fig. 1(a)], PMMA was coated to the thickness of 1.05 μm [Fig. 1(b)]. Then the gate region and the peripheral of the gate were exposed by 200 keV Be^{++} and 100 keV Be^{+}, respectively, with a dose of $2.0x10^{13}$ ions/cm^2 [Fig. 1(c)]. The exposure dose was determined so as to get the pattern width with a good agreement with the desired width. The exposure was performed by an FIB system with an accelerating voltage of 100 kV. Au-Si-Be alloy was used for the ionization material of the liquid metal ion source.

Thus, *Morimoto et al.* merely discloses exposure of a gate region and a peripheral of a gate region by a FIB system. However, nothing in *Morimoto et al.* shows, teaches or suggests etching a strippable film by focused ion beam as claimed in claims 10 and 17. Rather, *Morimoto et al.* merely discloses exposing a gate region and a peripheral of a gate by a FIB system.

Since nothing in *Morimoto et al.* shows, teaches or suggests etching a strippable film by focused ion beam as claimed in claims 10 and 17, Applicant respectfully requests the Examiner withdraws the rejection to claims 10 and 17 under 35 U.S.C. § 102(b).

Claims 11, 13 and 15 depend from claim 10 and recite additional features. Applicant respectfully submits claims 11, 13 and 15 would not have been anticipated withing the meaning of 35 U.S.C. § 102(b) by *Morimoto et al.* at least for the reasons as set forth above. Therefore, Applicant respectfully requests the Examiner withdraws the rejection to claims 11, 13 and 15 under 35 U.S.C. § 102(b).

Claims 1, 8 and 9 were rejected under 35 U.S.C. § 102(b) by *Kawabe et al.* (U.S. Patent No. 5,316,617).

Kawabe et al. appears to disclose first, as shown in FIG. 9A, successively formed on a substrate 12 were an alumina layer 14 as the base layer, a permalloy film 16 as the lower magnetic film, an alumina film 18 as the gap layer, a conductor coil 22 of copper, and an organic resin layer 20 as the insulator layer. Formed successively on the organic resin layer 20 were a permalloy film 24 as the upper magnetic film, an alumina film 26, and a permalloy film 28 constituting the mask for alumina etching. Subsequently, as

shown in FIG. 9B, a photoresist pattern 30 was applied to the permalloy film 28. Then, as shown in FIG. 9C, using the photoresist 30 as a mask, patterning was performed on the permalloy film 28 by ion beam etching using Ar gas. Subsequently, the photoresist 30 was removed, and, as shown in FIG. 9D, patterning was performed on the alumina film 26 by ion beam etching using a mixture gas consisting of 37 vol% of CH_2F_2 +CHF_3. Since in this process the permalloy film 28 serving as a mask is not etched at all as stated above, its film thickness may be small; in this embodiment, it was 0.5 μm. For practical use, it is desirable that the film thickness be set at 1 μm or less taking into account the film thickness variation in the substrate or between batches, the film peripheral portions in the device step section, etc. The side edge surface tapered angle of the alumina pattern 26 thus obtained was 82°. Subsequently, as shown in FIG. 9E, using the alumina film 26 as a mask, etching was performed on the permalloy film 24 by ion beam etching using Ar gas. In this process, the permalloy film 28, which had been previously used as a mask, was automatically removed because of its small film thickness. In this way, a method of manufacturing a thin film magnetic head having a high precision track width was realized. (col. 9, lies 12-45)

Thus, *Kawabe et al.* merely discloses patterning one film which is then used as a mask to pattern another film. Nothing in *Kawabe et al.* shows, teaches or suggests etching a strippable film and a thin film using focused ion beam as claimed in claims 1, 8 and 9. Rather, *Kawabe et al.* merely discloses patterning one film which is then used as a mask to pattern another film.

Since nothing in *Kawabe et al.* shows, teaches or suggests etching a strippable film and a thin film by focused ion beam as claimed in claims 1, 8 and 9, Applicant respectfully requests the Examiner withdraws the rejection to claims 1, 8 and 9 under 35 U.S.C. § 102(b).

Claims 1, 8 and 9 were rejected under 35 U.S.C. § 102(b) as being anticipated by *Hara et al.* (U.S. Patent No. 4,592,801).

Hara et al. appears to disclose in Fig. 4c shows a state that, after a photoresist material was applied to the whole surface of the alumina film 27 to form a photoresist film 28, and the photoresist film 28 has been exposed and developed so as to have a predetermined pattern which is identical with a final pattern of the upper permalloy film 23. FIG. 4d shows a state that an exposed portion of the alumina film 27 has been dry-etched by using the photoresist film 28 as a mask. The ion beam etching technique using a carbon fluoride gas was used for dry-etching the exposed portion of the alumina film 27. As shown in FIG. 4d, the photoresist film 28 on the remaining portion of the alumina film 27 is left, though the thickness of the film 28 is reduced. The photoresist film 28 does not change in property even after having been subjected to the ion beam etching which uses a carbon fluoride gas, and therefore can be readily removed by an oxygen plasma or an organic

solvent such as acetone. FIG. 4e shows a state that the upper permalloy film 23 has been etched by carrying out argon ion beam etching while using the alumina film 27 as a mask,

that is, a state that a patterning operation for the upper permalloy film 23 has been completed. If it is required to remove the alumina film 27 which has been used as the mask, the alumina film 27 will be readily etched off by the ion beam etching which uses a carbon fluoride gas or by phosphoric acid. However, in order to reinforce the thin-film magnetic head, it is usually required to coat the magnetic head with an inorganic oxide material. (col. 5, lines 40-68)

Thus, *Hara et al.* merely discloses dry etching an alumina film 27 using a photoresist 28 as a mask and then etching an upper permalloy film 23 while using the alumina film 27 as a mask. Nothing in *Hara et al.* shows, teaches or suggests etching a strippable film and a thin film using a focused ion beam as claimed in claims 1, 8 and 9. Rather, *Hara et al.* merely discloses dry etching an alumina film and then etching an upper permalloy film using the alumina film as a mask.

Since nothing in *Hara et al.* shows, teaches or suggests etching a strippable film and a thin film pattern using a focused ion beam as claimed in claims 1, 8 and 9, Applicant respectfully requests the Examiner withdraws the rejection to claims 1, 8 and 9 under 35 U.S.C. § 102(b).

Claims 1, 8-10, 17-19, 26 and 27 were rejected under 35 U.S.C. § 102(b) as being anticipated by *Nakamura et al.* (U.S. Patent No. 5,506,197).

Nakamura et al. appears to disclose as shown in FIG. 3A, an MgO (100) substrate 5 is prepared. As shown in FIG. 3B, a c-axis oriented $Y_1Ba_2Cu_3O_{7-\delta}$ oxide superconductor thin film 1 having a thickness of about 250 nanometers is deposited on a principal surface

of a MgO substrate 5. (col. 10, lines 23-27) Then, as shown in FIG. 3C, an Au layer 14 having a thickness of 30 to 100 nanometers is formed on the $Y_1Ba_2Cu_3O_{7-\delta}$ oxide superconductor thin film 1. As shown in FIG. 3D, a SiO_2 layer 15 having a thickness of 250 nanometers is formed on the Au layer 14 by a CVD. A center portion of the SiO_2 layer 15 is removed by using a photolithography. Using the processed SiO_2 layer 15 as a mask, center portions of the Au layer 14 and the $Y_1Ba_2Cu_3O_{7-\delta}$ oxide superconductor thin film 1 are selectively etched by a reactive ion etching using a chloric gas, an ion milling using Ar-ions or a focused ion beam etching so that the Au layer 14 is divided into a source electrode 12 and a drain electrode 13, the $Y_1Ba_2Cu_3O_{7-\delta}$ oxide superconductor thin film 1 is divided into a superconducting source region 2 and a superconducting drain region 3, and a portion 16 of the surface of the substrate 5 is exposed between them, as shown in FIG. 3E. As shown in FIG. 3F, an oxide layer 20 composed of c-axis oriented $Pr_1Ba_2Cu_3O_{7-\epsilon}$ is deposited on the exposed surface 16 of the substrate 5, by an MBE. The oxide layer 20 preferably has a half thickness of the superconducting source region 2 and the superconducting drain region 3. (col. 10, lines 38-54)

Thus, *Nakamura et al.* merely discloses removing a portion of a layer 15 using photolithography. Thus, nothing in *Nakamura et al.* shows, teaches or suggests etching a strippable film by focused ion beam as claimed in claims 1, 8-10, 17-19 and 26-27. Rather, *Nakamura et al.* merely discloses partially removing the center portion of layer 15 using photolithography.

Additionally, *Nakamura et al.* merely discloses that the processed layer 15 is used as a mask so that center portions of a layer 14 and a thin film layer 1 are selectively etched. Nothing in *Nakamura et al.* shows, teaches or suggests etching a strippable film using a focused ion beam as claimed in claims 1, 8-10, 17-19 and 26-27. Rather, *Nakamura et al.* merely discloses etching a layer 14 and a thin film 1 using a process layer 15 as a mask. In other words, the strippable film layer 15 is never etched using focused ion beam.

Since nothing in *Nakamura et al.* shows, teaches or suggests etching a strippable film by focused ion beam as claimed in claims 1, 8-10, 17-19 and 26 and 27, Applicant respectfully requests the Examiner withdraws the rejection to claims 1, 8-10, 17-19, and 26-27 under 35 U.S.C. § 102(b).

Claims 1, 2, 8, 10-11, 17, 19, 20 and 26 were rejected under 35 U.S.C. § 102(e) as being anticipated by *Allee et al.* (U.S. Patent No. 6,304,784).

Allee et al. appears to disclose in FIG. 5 a flow diagram showing a preferred method of manufacturing a flexible probing device having multiple non-planar integrated circuits as shown in FIGS. 1-4. The method includes the steps of: applying a first resist layer onto the outer surface of an elongated, substantially cylindrical flexible fiber (Step 502); patterning the first resist layer, using for example conventional electron or ion beam lithography, to form a pattern of multiple non-planar integrated circuits disposed along the outer surface of the fiber (Step 504); depositing one or more material layers, e.g. conductors, semiconductors, etc., onto the patterned outer surface of the fiber to form the

circuits (Step 506); removing remaining portions of the first resist layer (Step 508); depositing one or more insulating layers on the circuits and outer surface of the fiber (Step 510); applying onto the insulated fiber a second resist layer (Step 512); patterning the second resist layer using conventional electron or ion beam lithography to form an openings pattern in the second resist layer (Step 514); transferring the openings pattern into the insulating layers to form a plurality of openings in through which the circuits are exposed (Step 516); and removing remaining portions of the second resist layer (Step 518). The fiber is then cut to size as required (Step 520). (col. 5, line 66 through col. 6, line 21)

Thus, *Allee et al.* merely discloses patterning a resist film using FIB. Nothing in *Allee et al.* shows, teaches or suggests etching a strippable film by focused ion beam as claimed in claims 1, 8, 10, 17, 19 and 26. Rather, *Allee et al.* merely discloses patterning a resist film.

Additionally, nothing in *Allee et al.* shows, teaches or suggests that any of the material layers were insulating layers or thin films as claimed in the claims. In particular, *Allee et al.* does not show, teach or suggest forming a strippable film on a thin film and etching the strippable film and the thin film using focused ion beam as claimed in claims 1, 8, 19 and 26. Also, *Allee et al.* does not show, teach or suggest depositing of the material layers to form circuits is the same as forming a thin film or that the strippable film is removed as claimed in claims 10 and 17. Rather, only portions of the first resist film in *Allee et al.* are removed. Additionally, *Allee et al.* does not show, teach or suggest that a

strippable film is formed on a first film as claimed in claims 19 and 26. Also, the material layers that are deposited in *Allee et al.* are not indicated as being a second thin film as claimed in claims 19 and 26.

Since nothing in *Allee et al.* shows, teaches or suggests etching a strippable film by focused ion beam as claimed in claims 1, 8, 10, 17, 19 and 26, Applicant respectfully requests the Examiner withdraws the rejection to claims 1, 8, 10, 17, 19 and 26 under 35 U.S.C. § 102(e).

Claims 2, 11 and 20 depend from claims 1, 10 and 19 and recite additional features. Applicant respectfully submits that claims 2, 11 and 20 would not have been anticipated by *Allee et al.* within the meaning of 35 U.S.C. § 102(e) at least for the reasons as set forth above. Therefore, Applicants respectfully request the Examiner withdraws the rejection to claims 2, 11 and 20 under 35 U.S.C. § 102(e).

Claims 3, 12 and 21 were rejected under 35 U.S.C. § 103 as being unpatentable over *Allee et al.* and further in view of Japanese reference 04251853. In addition, claims 4-7, 13-16 and 22-25 were rejected under 35 U.S.C. § 103 as being unpatentable over *Allee et al.* and further in view of Japanese reference 01-175232.

As indicated above, since nothing in the primary reference to *Allee et al.* shows, teaches or suggests etching a strippable film and a thin film using focused ion beam as claimed in claims 1, 10, 17, 19 and 26, Applicant respectfully submits that the combination of the primary reference with the secondary references would not overcome the

deficiencies of the primary reference. Therefore, Applicant respectfully requests the Examiner withdraws the rejection to claims 3-7, 12-16 and 21-25 under 35 U.S.C. § 103.

Thus it now appears that the application is in condition for reconsideration and allowance. Reconsideration and allowance at an early date are respectfully requested.

If for any reason the Examiner feels that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed within the currently set shortened statutory period, applicant respectfully petitions for an appropriate extension of time. The fees for such extension of time may be charged to our Deposit Account No. 02-4800.

In the event that any additional fees are due with this paper, please charge our Deposit Account No. 02-4800.

Respectfully submitted,

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